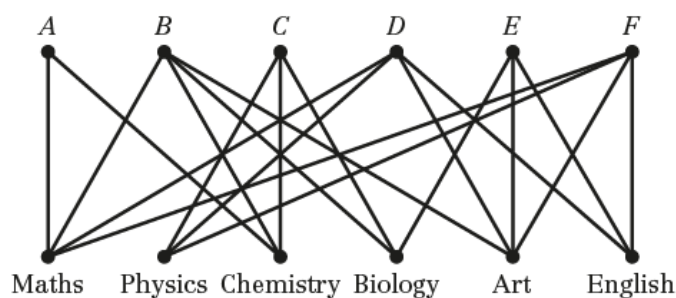


## Exercise 2A

- 1 a i a student  
 ii friendship, i.e. that a pair of students are friends
- b Banjit, Dhevan, Esme
- c The pairs which do not have mutual friends are: Esme and Govinda, Chris and Esme, Esme and Adok, Adok and Banjit, Banjit and Chris. Adding friendships: Adok and Chris, Esme and Fabio solves the problem.

2 a



- b The subjects with the largest number of arcs (4) are Maths and Art, so these are the subjects studied by most students.
- 3 a i E.g. Marylebone to Oxford Circus to Victoria has one change at Oxford Circus.
- ii E.g. the same route as in part i passes through 3 stations and this is the minimum number.
- b i E.g. Kings Cross St Pancras - Green Park - Waterloo; 4 stops + change + 2 stops give 11 min.
- ii E.g. Holborn - Oxford Circus - Victoria - St James's Park; 2 stops + change + 2 stop + change + 1 stop give 12 min 40s.
- iii Victoria - Green Park - Baker Street; 1 stop + change + 2 stops give 7 min.

4 a 40 min

b Aberdeen - Cork (118min)

4 c Dublin - it is the airport with most connections.

5 a *PTV*

b The student is not correct - *PTQRSV* is shorter (25km).

### Challenge

- a Minimum length is 3. We need to go once up, once to the right and once into page. However, we can do it in arbitrary order, e.g. up - right - into page (*AEFG*) or into page - right - up (*ADCG*). Hence, by considering all permutations we get 6 different routes.
- b First note that all routes must have odd length. Moreover, we cannot use more than 7 arcs. Hence, all allowed routes have length 3, 5 or 7. There are 6 routes of length 3. We can use these to construct routes of length 5 or 7. For example, we can extend *AEFG* to *AEFBCG* and to *AEFBCDHG*. We can realise that this way each route of length 3 gives rise to exactly one route of length 5 and exactly one route of length 7. Hence, we conclude that there are 18 allowed routes (6 of length 3, 6 of length 5 and 6 of length 7).